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COGENERATION IN STATE FACILITIES

BACKGROUND

In July, 1986, the Executive Office of Energy Resources (EOER) initiated the investigation of Cogeneration Potential in State Facilities. The interest in this investigation was generated by the recognition of the inherent energy efficiency of cogeneration technology and potential economic benefits to the Commonwealth. The study has been conducted in close coordination with the Division of Capital Planning and Operations (DCPO), the agency which owns and and manages the capital development of all state facilities.

Following a competitive bidding process, Pequod Associates of Boston was selected to conduct the study. Their work resulted in the following products:

Cogeneration Case Studies: Technical and economic analyses of cogeneration system options at fifteen (15) representative state facilities

Statewide Analysis: a projection of the potential for cogeneration throughout state facilities based on an extrapolation from the case studies

Cogeneration Development Strategy: Recommendations for technical, environmental, legal, financial and institutional strategies for statewide cogeneration development

Cogeneration Technology Guide: a guidebook to cogeneration systems for DCPO, state agency and facility staff

Cogeneration Screening Mechanism: a tool for evaluating cogeneration opportunities at specific facilities for the use of DCPO, state agency and facility staff

EXECUTIVE SUMMARY

The following discussion summarizes the consultant's conclusions and recommendations contained in the Statewide Analysis and Cogeneration Development Strategy.

Statewide Analysis

The Statewide Analysis identifies the common issues among the case studies and extrapolates the findings to the inventory of state facilities. The consultant has identified the maximum total capacity based on maximum capacity systems at each facility. These capacities have been assigned by extrapolating the results of the fifteen site analyses.

Two classes of engine-based cogeneration systems are used in this evaluation. The engines are high efficiency diesel engines firing heavy or light fuel oil and high efficiency spark ignition engines firing natural gas. High efficiency diesel engines produce a net increase of NO_x over the existing heating system and power stations generating the same amount of heat and power. High efficiency spark ignition engines firing natural gas typically produce no increase in NO_x, and depending on the particulars, may produce a net reduction in NO_x.

There is a statewide potential for as much as 245 MW of cogenerated power with the implementation of high output, heavy fuel diesel based engines. With a three year payback, the annual net income represented in the analysis is roughly $75,000,000. The cogenerated heat produced will provide roughly 35% of the heat currently used at all state facilities.

The environmental impact of this projection is significant. The increase of NO_x emissions is roughly 15,000 tons per year. This does not include the reduction due to the elimination of utility emissions corresponding to the generation of the 245 MW output for 8,000 hours/year. If this offset is included, then the net increase of NO_x output is reduced to 8,000 tons per year.

Cogeneration Development Strategy

The Cogeneration Development Strategy explores issues surrounding implementation on a large scale. It focuses on how to organize for and approach the task and overcome the major obstacles to a successful statewide cogeneration plan.

The benefits to the state are discussed. These include placing the Commonwealth in a position of leadership not only among other potential cogenerators in the private sector but among the other New England states with a responsible, cost-effective strategy for developing new electric generating capacity. The following points summarize the particularly positive effects.

New Capacity:

The Commonwealth has determined that expected load growth in New England will require 1000 MW of conservation or alternate power production in the next five years. This study has identified as much as a quarter of the total requirement as the potential at state facilities.

Operating Cost Avoidance:

The consultant projects that implementation of the full 245 MW is capable of saving $72 million annually. Depending on how project financing is structured, these savings would be spent to recover capital costs, pay private vendors or offset facility operating costs. Rough estimates indicate

that the net present value of the resulting net income to the state is at least $175 million.

Energy Efficiency:

Cogeneration is inherently efficient, provided that there is substantial use of the heat produced. The projected statewide potential is based on an average use of about 50% of the available cogenerated heat. If the full potential were on-line and ran 8,000 hours/year, fuel consumption in Massachusetts would decrease by nearly a million barrels a year.

SO_2 Reduction:

With the reduction in oil burned and the requirement for 1% or less sulfur oil for cogeneration, there is a significant reduction in total SO_2 emissions statewide with cogeneration. With the full 245 MW program described in the Statewide Analysis, SO_2 reduction could amount to over 4,000 tons/year or 40% of the Massachusetts SO_2 emissions cap target reduction for the four years beginning in 1987.

Constraints to Implementation:

The following issues were identified as the major constraints to cogeneration at state facilities. They incorporate the physical issues extrapolated from the case studies and the contextual issues discussed in Section 2.0 of the Cogeneration Development Strategy.

The obstacles to implementation explored include:

Environmental Impact:

In no case should the statewide plan violate or appear to violate accepted standards, published or otherwise. This approach will generally increase capital cost and operating expense with adverse impact on the economics of statewide implementation. Converting from the best economics to the lowest environmental impact increases simple payback from 3 to 5 years and reduces capacity by about 40%. In the opinion of the consultant, the long payback could reduce the availability of private investment as a source of capital and ownership; the lower capacity is a significant reduction in one of the primary program goals.

Public Relations:

On a statewide scale, severe public opposition seems unlikely considering the objectives of reduced cost and energy efficiency. It is essential that environmental concerns be addressed in the design of a statewide program and incorporated into the development of each cogeneration system.

Utility Requirements:

Under almost every circumstance for cogeneration at state facilities, the equipment will be connected in parallel with the utility grid. The connecting utility has a responsibility to ensure that the interconnect is properly designed and constructed. A more fundamental concern will be for the reliability of the proposed system. If power is being sold on contract to the utility and a certain value for new capacity is included in that price, then reliability is a critical issue. The power must be available when the utility needs it. Reliability has to be demonstrated during contract negotiations and the price a utility will pay depends on its assessment of that reliability.

Recommendations:

Recommendations address key issues which have been raised in the case studies and the discussion of strategy. They include:

Organization:

In the opinion of the consultant, the potential for 245 MW of cogeneration at state facilities is great enough to warrant a separate division in DCPO to manage the program, initiate studies, issue RFP's for private development, qualify developers, let contracts and monitor compliance/revenue. It is recommended that this group be overseen by a Cogeneration Board responsible for setting implementation goals, reviewing progress and recommending developer selection.

Environmental Strategy:

The statewide plan for cogeneration should anticipate tighter regulations for NO_x, SO_2 and hydrocarbons and "lead the pack" in the strategy to comply with the projected standards. The study contends that emission control technology is continually advancing and recommends a system of state subsidies as inducements to developers to seek out technological improvements and retrofit systems to meet increasingly stringent environmental requirements.

Fuel Strategy:

Since Massachusetts is at the end of the distribution system for both gas and oil, it is prudent to encourage dual fuel applications where fossil fuel will be burned. It is recommended that the Commonwealth seek special contract carriage rates for gas purchases and/or favorable long term fuel oil supply contracts.

Investment Strategy:

Four different options for the ownership/development of cogeneration in state facilities were examined: private developer, state agency, DCPO and a new state cogeneration authority. The consultant recommended that private companies be selected to finance, develop, operate and maintain cogeneration systems in state facilities. This strategy will shift significant developmental and operational risks from the state to the private sector.

FOCUS QUESTIONS

As indicated in the Executive Summary, there are a number of issues raised in the study which must be resolved in the process of developing an implementation plan. EOER requests that participants in the public hearings address their testimony to the following specific questions:

1. Technical Feasibility- The study concluded that diesel reciprocating engines burning heavy fuel oil are most cost effective and least sensitive to fuel price fluctuations, but have substantial environmental costs. Are there alternative technologies which offer widespread applicability and which would more closely meet the economic and environmental criteria of the Commonwealth?

2. Environmental Implications- How can a statewide implementation strategy achieve a substantial amount of cost effective cogeneration without negative environmental effects? The study recommended that private developers be paid inducements to invest in environmentally sound cogeneration technologies. Are there alternative strategies to achieve environmentally sound development?

3. Investment/Strategy

   The consultant has assumed a three-year simple payback as the criteria for private investment. Is this an accurate threshold or are there other criteria associated with cogeneration in state facilities which would allow a longer acceptable payback?

   The study concluded that private financing and development was the preferred mechanism for development. What are the comparative risks and benefits to the state of private development vs. public development? Are there circumstances where public financing or a public/private partnership arrangement would be more beneficial?

4. Operation and Maintenance

Reliable, long term operation of the cogeneration equipment is essential if the electricity generated is to be sold to a utility company. What precautions or arrangements will the state be able to make to ensure that operations and maintenance is performed in a satisfactory manner?

5. Institutional Framework

The consultant examined the possibility of a created authority which would have the power to raise revenues, develop, own and operate state cogeneration systems. They concluded that, because of anticipated resistance to creating a new independent authority, the recommended framework would be the creation of a cogeneration division within DCPO which would be overseen by an independent Cogeneration Board. What are the costs and benefits of the alternative options? Are there other institutional structures which would expedite development?

6. Contractual Issues with Utilities

The consultant recommended a buy-all, sell-all arrangement with the electric utilities in order to avoid the difficulties and expense related to back-up power. Will this arrangement be the most financially beneficial to the state? What concerns will utilities have regarding the purchase of power from state facilities? What contractual provisions will be required?